My Musical Language: An Approach to Composing in Just Intonation

Thesis

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by

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Genesis:

As a composer I have incorporated many concepts outside of my own culture into my musical language. The rate in which the world has shrunk during my lifetime has allowed me to explore a wealth of esoteric knowledge. The Javanese and Balinese musical traditions have been a constant source of inspiration for my work. The variety of tunings present in these musical traditions has always intrigued me. I often have a visceral reaction to unfamiliar tuning systems and have been intrigued by their psychoacoustic effects. I can remember the first time I heard a Balinese Gamelan and how I was struck by the tuning it employed. This discovery forever changed my path through the infinite continuum of information and knowledge we call music.

One evening I followed paper signs that read "gamelan" with an arrow pointing forward into the dark basement of the George Eastman Theater. George Eastman was the man who built my hometown of Rochester, New York. Eastman did so not just with his company Eastman Kodak, but also with his love of cinema and music. He built the theater after the American workweek was shortened to forty hours as a way to entertain the workers in his company. He was concerned that the extra free time would allow his employees more opportunity to submit to their vices so the theater was constructed to serve the community as a silent movie house on weekdays and as the home of the Rochester Philharmonic on the weekends. The theater is housed in the same building as the Eastman School of Music. When you grow up in the Rochester area these days all you get to see is the ghost of the town that George Eastman knew and loved. The Eastman School may be the only legacy he left Rochester that has not been dismantled, outsourced, or laid off.

The bowels of this storied building must have appeared to the conservatory administration as the perfect place to segregate the dangerous ideas of community, equality, and lightheartedness innate to gamelan music from the school's precious Western classical music tradition. I suspiciously opened a door I feared would lead me to a boiler room or utility closet to find a small hallway adorned with posters of shadow puppets and gongs. Through the hallway was a room filled with beautiful instruments; bronze bars hung over ornately carved wooden cases, drums covered in wild checker-patterned material, and baskets full of little wooden hammers. I sat down and prepared to listen to a music I had never experienced before. I remember being so ignorant that I asked the very white and very American teaching assistant if he was Balinese.

The players soon arrived and activated the air molecules of the room with an awe-inspiring sound. My inner ears were pelted relentlessly with the audible beating produced by the unique Balinese tuning system. The amplitude and sweet dissonance of the instruments completely overwhelmed me as interlocking rhythms were hammered out of the hard metal keys and gongs. I did not know at the time the long-lasting significance that day would have on my life. My preconception of how music could sound and how it could be organized was shattered. My perception of pitch was challenged to the point where I have not since been satisfied with the dull sounds and limitations of equal temperament.

I joined the Eastman School of Music’s gamelan ensemble as a community member and was introduced to a network of visual artists, musicians, and scholars who championed the exploration and incorporation of non-Western concepts in art and in life. The cyclical rhythms, modal constructions, microtonal nuances, and drones of the musics

of India, Persia, and Indonesia were introduced to me as essential aspects of world music and have lead me to extensive research on these topics. These different characteristics and rich musical traditions have become part of my compositional vocabulary, but it was ultimately my exposure to Gamelan in the basement of that old theater that marked the true beginning of my life as composer and the genesis of my musical language.

Musical Language:

There are two main considerations a composer must make when creating and defining a musical language. The first consideration is the amount of importance to be placed on defining his or her music, theories, and its place within a larger historic and cultural context. A composer can find comfort by defining his or her approach according to the ideas that precede it, and acknowledging its role as part of a linear historical progression.

Arnold Schoenberg is an example of a composer who was able to assimilate historical trends and codify a system. When he stated that his twelve-tone system had assured the dominance of German music for the next century, he was demanding recognition as the heir apparent of a German lineage of great composers exemplified by Bach, Beethoven, and Wagner. The twelve-tone system was indeed not a rebellion against the norms of the preceding tonal language nor an abandonment of the German tradition, but a natural progression and evolution from expanded tonality.

A composer can seek to legitimize his or her work by imitating prior trends and periods of music. This is done most often with aesthetics that have already been deemed successful by important institutions that decide such things (scholars, critics, audience, et

al.). This can be thought of as a conservative approach to music. Rachmaninoff became one of the most performed and celebrated composers of the twentieth century by writing Romantic music long after his peers had abandoned Romanticism. I fail to see the need to criticize Rachmaninoff because he was able to transform the Romantic musical language into something quite unique.

The second approach to defining a personal musical language is to place more emphasis on the creation and exploration of new and experimental ideas in order to create a more personal and unique musical language. Although I believe that it is futile for one to believe that anyone can completely divorce art from its historical and cultural reference, an artist can certainly try. When a composer decides to abandon tradition he or she must be aware of exactly what is abandoned. No matter how one defines a musical language, the most important step is to become completely fluent in music history and contemporary musical practice.

My training as a visual artist did not begin with abstract expressionism, but with countless hours of perspective drawings and still life painting. Similarly, a composer's training starts with species counterpoint exercises and stylistic imitation before moving on to free-form composition. An artist must learn all of the rules in order to know which ones to break. Rebellion in art and life must have a defined intent if it is ever to be successful and long standing.

Composers who champion such an abandonment (or at least perceived as such) of tradition and historical context in search of their own musical language are easy to identify in the American experimentalist tradition. Perhaps no one embodies a departure from contemporary aesthetic practice more than Harry Partch. He was a composer who

focused his efforts on alternate tuning systems as a means of expression and a rebellion against popular trends in music. Even as serialism dominated and minimalism emerged as the new avant-garde, Partch existed as a true rebel and outsider.

Partch was a very skilled instrument builder, mathematician, and composer. He theorized numerous tuning systems that utilize just intonation and brought these theories to life on instruments of his own design. Partch designed an orchestra of instruments to realize his new and experimental approach to music. Although one could argue that Partch was approaching music and theory in the philosophical tradition of Pythagoras and others, Partch was truly a maverick in terms of the sonic world that he created with his compositions. His incorporation of folk and hobo songs into his music is something that also sets him apart from many composers as well.

When composing I try to take all of the aforementioned principles into account. I do not think that I will ever be able to be the experimentalist that Harry Partch was nor as conservative as Rachmaninoff. I will always try to strive for a balance. One thing that I know for sure though is that I have little to no interest in composing music in equal temperament unless I am required to due to the restrictions of the ensemble and instruments at my disposal. The following pages represent the coalescence of my approach to just intonation, gamelan, and aesthetics.

Tuning:

Musicians, philosophers, and mathematicians have explored tuning systems since the very beginnings of music itself. Just intonation is a rich source of inspiration and expression for composers. During my time at Mills I have been exploring historical and

contemporary tuning systems and how they can be manifested on the piano. I have found that tuning systems themselves can become an outlet for creative expression. By exploring different tuning systems and solutions a composer can open up limitless possibilities for composition. Once deciding to work within the bounds of a tuning system, a composer must contextualize and apply the qualities of the system within a musical language.

Just intonation is based on the properties of the harmonic series, and focuses on simple number ratios to derive pitch frequencies instead of the irrational, or compromised intervals found in any tempered system. For instance, equal temperament takes the octave and divides it into twelve equal intervals. One can easily observe just-tuned intervals by listening closely to the sound of a single note played on a piano. The complexity and perception of the sound is the result of the distribution of harmonics in relation to the fundamental or loudest tone. The harmonic series can also be observed in the human voice. Every person has the same or similar instrument (or anatomy) for creating speech but the different distributions of harmonics, as well as other factors, give each person's voice unique characteristics.

Just intonation can be applied to a number of different instruments, but some instruments are better equipped than others. The human voice as well as string instruments such as the violin actually lean more towards just intonation, since the human ear will favor just intervals. Guitars and other instruments that are manufactured with fixed tunings do not function in just intonation as well. Synthesizers and oscillators can be tuned, though some analog synthesizers can be difficult to tune precisely.

When I decided to immerse myself in just intonation I knew that I wanted to start by developing a keyboard tuning. The number one reason for doing this is because when performers (such as a string player) is presented with a new and unfamiliar tuning system he or she has to be taught the intervals, learn how to identify them aurally, and retrain their muscle memory to execute them with precision. When a composer applies a tuning system to a piano after the instrument is tuned, the performer does not in any way need to change the mechanics of how he or she plays the instrument. A notated D3 on the page instructs the performer to push the D3 key on the keyboard and activates the corresponding string no matter what the frequency is. This takes a lot of the guesswork out of just intonation and puts the responsibility of the intonation on the composer not the performer.

In order to develop my specific tuning system I used a software instrument called "Midi Keyboard Tuning" designed by Chris Brown for the open source digital music programming software SuperCollider. Brown's software allows the user to input user defined tunings by simply entering tuning ratios into the programming code. This easy to use software allowed me to experiment with and listen to an array of different intervals in just intonation. I created my own just intonation, 7-limit system (a system that derived from the first five prime partials of the harmonic series) comprised of the following intervals based on A440:

Example 1:

Ratio	Note	Cents	+/-
1/1	A	0	+/-0
16/15	A#	111.7	+11.7
9/8	B	203.9	+ 3.9
6/5	C	315.6	+15.6
21/16	C#/D	470.8	+70.8
4/3	D	498.0	-2.0
45/32	D#	590.2	-9.8
3/2	E	701.955	+1.955
14/9	F	764.9	-35.1
5/3	F#	884.4	-15.6
9/5	G	1017.6	+17.6
63/32	G#/A	1172.7	+72.7
2/1	A	1200	+/-0

When choosing the ratios for my system I did not try to do anything adventurous or profound. Historically the two most important considerations with a tuning system are: how does it sound and how easy is it to tune. I simply wanted to define a system that I could easily understand and that sounded good. I looked at a number of different five and seven limit tuning systems and simply used the intervals I thought sounded the best, borrowing the 21/16 and 63/32 ratios from La Monte Young's tuning used in *The Well Tuned Piano*.

After constructing this tuning the next step was selecting an acoustic instrument on which to hear it. I placed a small grand piano into this intonation, and after devoting a considerable amount of time improvising on the instrument I began to derive modes from the tuning. Knowing that deriving modes from each note as a tonic would yield more pitch information than necessary for the piece I intended to write, I created modes using keys based on A, D, and E as the tonic. I knew that the very simple interval relationships

between these notes would allow for easy modulations.

From that point, I approached choosing the pitch collections from an intuitively. I knew that I wanted to use pentatonic modes that would lend themselves to the feeling or approximation of the *slendro* scale used in gamelan music. I knew that applying the interval structure from the major and minor diatonic scales would be a good reference point as well. I generated every possible collection of five notes and improvised with each collection until I identified the ones that sounded the best to me. At the same time I also generated all of the possible tetrachords available and went through the same intuitive process as I applied to the five note collections. A feature that became apparent during this process was that the G#/Ab and the C#/Db are so close in pitch that they can function as a alternate or different color used to embellish the pitches A, and D respectively. This characteristic of the tuning is something that I tried to exploit during my writing process.

The modes that I use in my *Suite for Just Intonation Piano* are:

Example 2:

Modes By Movement	
I.	G-B-C-E-F
III.	D-E-F-G#-A#, D-E-F-A-Bb, D-E-F-G-B
IV.	E-F-B-C
V.	A-B-D-F-(G)

When deriving my collection of modes I had to make sure that I considered the tradition I was referencing. In the Gamelan tradition there are two different tuning systems or *laras*: *slendro* and *pelog*. *slendro* is a tuning system with five notes to the octave that could be thought of as similar to a 5-tone equal temperament as the pitches are traditionally spaced

quite evenly from each other; while *pelog* features seven quite uneven intervals to the octave, though in traditional pieces only five notes of the *pelog* scale are used. It is important to mention that neither of these tuning systems are harmonic tunings and thus did not serve as inspiration to my actual tuning system but only the organization of my compositional method.

Composition:

In order to best illustrate my explorations of both just intonation and Gamelan music, I decided that I would write several pieces and classify the entire work as a suite. The construction of the piece has no clear resemblance to a suite in the Baroque or Classical sense. The suite as defined by tradition is comprised of a series of pieces each written within the constraints of certain forms and styles. I instead have chosen the term suite to represent a collection of pieces held together by a common aesthetic goal.

In the Fall of 2009 I wrote a *Suite for Solo Harp*, and with each different piece I realized a different mode or scale and applied it to a contrasting rhythmic concept. Through doing this I found the process to be a lovely way for a composer to express numerous, and sometimes contrasting, compositional ideas, forms, and decisions without having to emphasize transitional material that can make a large-scale work seem cumbersome.

When I first decided to compose *Suite for Just Intonation Piano* I wanted to model the form of the movements (at a very basic level) on the symmetric form of Bartók's Fourth String Quartet. The first and fifth movements are similar in form and character, as are the second and fourth. The third movement stands on its own, and is an

"axis" for the entire work. At the onset of composing my suite I intended to adhere to this formula quite strictly, but later modified it to serve my overall cohesiveness of the suite.

Suite for Just Intonation Piano is comprised of five different pieces. The first, third, and final pieces in the suite are arrangements of compositions I originally wrote for a full Javanese Gamelan. The first and third movements are written to express the same Javanese form, *ladrang*. The inner movements are explorations in resonance that focus on shifting timbral color to show the unique features of my tuning system. One thing that all of the pieces have in common is that they are written with the intention of being repeated. This is a product of the cyclical nature of gamelan music on which I wanted to base the entire work. The fifth movement expresses a personal take on the Javanese form, *Bubaran*, to contrast with the first and third movements. The most apparent dichotomy within the suite is the divergent approaches to composition, contrasting the three melody-driven gamelan arrangements, and the other the two timbral studies. This dichotomy demonstrates the wide variety of musical possibilities that can be derived from my tuning system and was essential to my compositional decisions.

Under the guidance of Daniel Schmidt, one of the innovators of American Gamelan music and a builder of numerous gamelans, I began to familiarize myself with Javanese forms and compositional practices. One day I approached Daniel and asked him what I should do in order to start writing for gamelan, to which he replied: "Start putting numbers down on paper and bring them to me next week." So with Daniel's permission I started writing several short gamelan pieces each week, and began pouring through Judith Becker's thick books full of thousands of traditional pieces in order to memorize terminology, compositions, cadential phrases, and other esoteric jargon. After over a year

and a half and dozens of compositions, the end result was just a handful of really strong compositions crafted in adherence to traditional Javanese gamelan music that I continued to develop and arrange. Three of those pieces became movements in my *Suite*.

Taking a composition for a full Javanese orchestra and condensing it to one instrument takes a lot of consideration. This transformation from the gamelan orchestra to the piano is one of the reasons I decided to add an optional percussion line to the score. The percussionist simply reinforces the gong cycle already represented in the piano orchestration. The primary step in arranging these pieces was to take modes I favored from the tuning system and to transfer them to the cipher notation used in Gamelan. This translation from Western notation to cipher notation is quite simple since cipher notation makes no reference to actual pitch, only scale degrees.

Modes or *pathet* are derived from each tuning system and tonicize one of the pitches. The way in which the note is tonicized is by occurring as the last note of a gong cycle. As is true in Western music there is a hierarchy of pitches in each of the Javanese modes as well as cadential phrases that further establish this hierarchy. Though terms like tonic and dominant cannot be applied to Javanese music, they can serve as a point of reference to organizational structures in Javanese music.

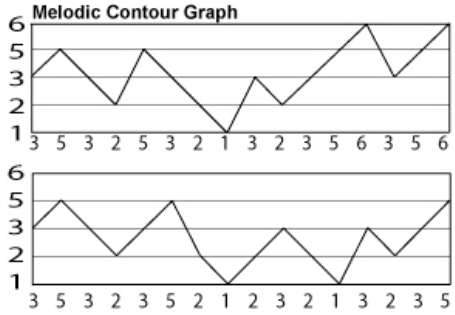
In my piece I only employ the *slendro* tuning system. In *slendro* there are three different modes, *nem* which has a tonic on scale degree 2, *sanga,* with a tonic on scale degree 5 and *manyura,* with a tonic on scale degree 6. Though there is no standard tuning of gamelan instruments, when a gamelan is constructed it is often tuned specifically to a certain mode. For example, the bronze gamelan at Mills College is tuned specifically to *manyura*. In addition to having different intervallic structures, each mode is associated

with a different time of day. The first and third movements of my piece express *sanga,* the mode tied to the night.

The first movement, a *ladrang*, displays *sanga* in a very traditional way. Each melodic line leads to the 5th scale degree occurring at the gong. I decided to use just one of two gong cycles that make up the *ladrang* form. Since I was aware that the form would be present in an expanded context in the third movement I did not want to exhaust the idea at the beginning of the piece. The worst thing that you can give a listener is more of something when they want less.

When composing the *balungan* or colotomic structure of the piece, close attention was paid to the melodic contour of the lines. An essential tool that I use to visualize this aspect of the music is to graph the lines so I can further understand the interplay between different moments in time. In my graph the vertical axis represents the possible pitches with the lowest tone placed on the bottom. The horizontal axis represents the succession of pitches of the *Balungan.*

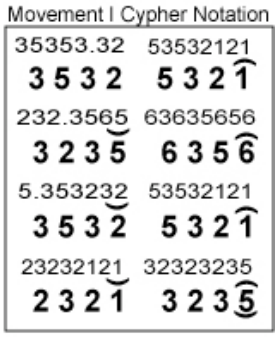
Example 3:



After finalizing the pitches based on the melodic contour I convert my graph to cypher notation. The numbers in bold represent the *balungan* while the numbers above represent notation for one of the *panerusan* or elaborating instruments, a set of pot gongs

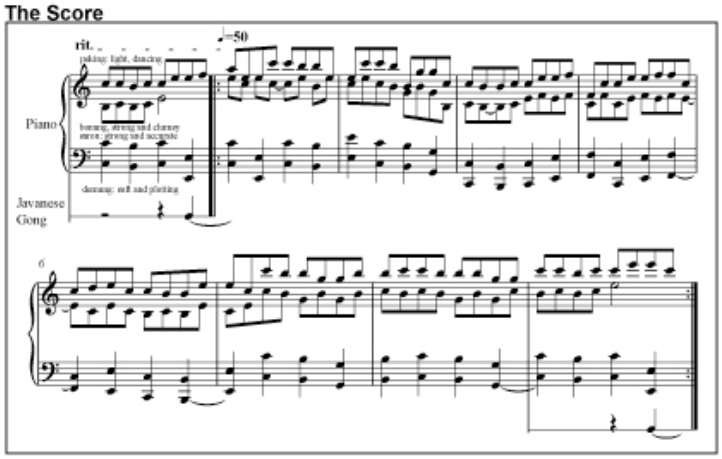
known as a *bonang.* Other instruments are notated as well; the notation above the notes at the end of each line demarcate the notes played by a larger set of pot gongs known as the *kenong,* while the same symbol displayed upside down represents the notes played by a set of hanging gongs know as *kempul*. The combination of the two symbols seen at the end of the piece represents the large gong.

Example 4:



The next step in the process was to take the cypher notation and translate it to Western notation. I decided to assign a Gamelan instrument to each voice based upon register. In addition to the distinction in register I also placed gamelan instrument names within the score next to the appropriate voices to further distinguish the orchestration to the performer. The lowest tones were reserved for the large gong, *kempul* and *kenang*. In the Gamelan the *demung* strictly beats out the *balungan*, which I also assign to the left hand of the piano. The ornamented pattern played by the *bonang* was given to the inner voice of the right hand and the highest voice assumed the role of the *peking*.

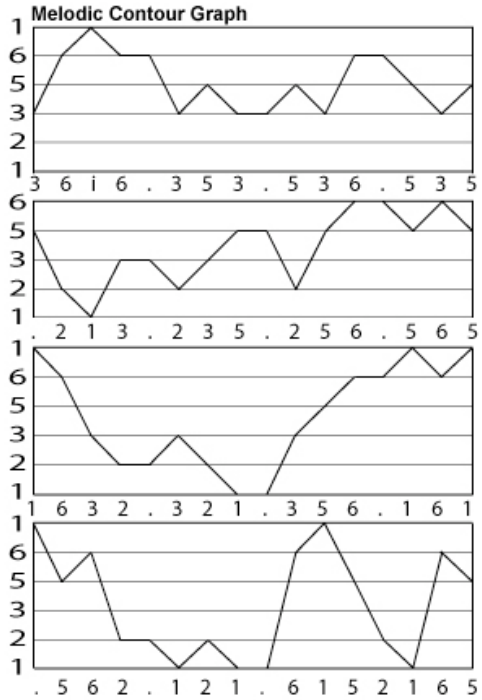
Example 5:



The third movement portrays *sanga* through a series of modulations and transformations, which differs greatly from the Javanese system. Since a Gamelan would need multiple sets of instruments or need to swap out the keys of the instruments to modulate the tuning of their *slendro* scale, I took this opportunity to exploit the possibilities of the piano. Each one of the three pages that make up the movement expresses a different mode in relation to *slendro*. Each *gongan* has a *selay* (goal tone) of scale degree 5 but the scale changes. Not only do the modes change but the ornamental line changes to enhance or obscure the inner melody of the piece to change the listener's perception of the formal process.

The longer the composition is the more I consider the melodic shape of the piece. The third movement spans two gong cycles. In order to create the most elegant and diverse *balungan* each line was constructed to contrast in shape while still maintaining qualities that I found to be pleasing. This contrast leaves room for the *panarus* line to explore register and continuously vary.

Example 6:



Example 7:

Cypher Notation

21532153	21532153
3 6 i 6	**. 3 5 3**
3 6 3 5	2356165
. 5 3 6	**. 5 3 5**
21562156	21562156
. 2 1 3	**. 2 3 5**
5 6 5 3	5 6 5 5
. 2 5 6	**. 5 6 5**
531653165	3165316
1 6 3 2	**. 3 2 1**
5 6 3 5	3256561
. 3 5 6	**. 1 6 1**
13561356	13561356
. 5 6 2	**. 1 2 1**
5 6 3 5	1 6 1 .
. 6 1 5	**2 1 6 5**

Modulation Chart

D	E	F	G#	A#
D	E	F	A	Bb
D	E	F	G	B

The fifth movement is in the three-line *bubaran* form. I decided to use a more stripped down orchestration in order to highlight some different approaches to ornamenting the *balungun*. Traditionally, the *bubaran* is played at the end of a concert to cue the audience that it is time to leave. The gamelan will then proceed to repeat the form until the entire audience has left, ending the concert. This movement was not only the first piece I arranged, but also one of the first pieces I composed for gamelan. Normally this form consists of three lines of equal length, but I expanded upon the form shifting between measures of 4/4 and 5/4 in order to defy the expectations of the listener. Another feature of this movement that makes it unique is the lack of a strong inner melody. I instead rely mostly on an ornamental melody to hold the piece together.

Example 8:

Movement V Cypher Notation

(6 . . i | . . 3 2 | . 3 . . 5 | . . 3 2 1 |

| 1 . 2 1 | . 2 . 3 | . 1 . . 2 | . 3 . 2 | . 5 . 3 2 |

| 5 . 3 5 | . 3 . 2 | . 5 . . 3 | . 2 . 3 | . 1 . 3 5)

Example 9:

The second movement is the first of two timbral studies in the suite. The hands of the piano alternate notes of an F#-G-G#-A-A#-B cluster in 6/8. I found this cluster by improvising and made note of it because of the elegance of audible beating present. By holding the pedal of the piano down the sympathetic vibrations add a really nice effect. I then decided to have a percussionist play a tam-tam inside the lid of the piano to further activate the sympathetic vibrations of the piano. To my surprise this applied resonance brings out the most beautiful harmonic. To further add to the complexity of the piece there is a constant and gradual accelerando from beginning to end.

Example 10:

The fourth movement (and second timbral study) is a series of ostinati all based on the tetrachord, E-F-B-C. The inspiration for this movement is the sound of arpeggios being played on a heavily distorted electric guitar. Every four measures the pedal is cleared to emulate the muting of strings that happens when changing finger position on a guitar. This also allows for the resonance of the piano to build and diminish. I chose a tight voicing of the tetrachord because voicings such as this are more difficult to achieve on the guitar than piano.

Further Considerations:

I have always been intrigued by the way things sound first and how they work second. Having a piano dedicated to my tuning that I can play on a regular basis has given me the opportunity to listen without having to be bogged down with how things work. I say this because I have had the ability to listen to the tuning for hours and as a result I can write intuitively. This has been invaluable to my compositional process. After all, how it sounds is the most important thing in writing music! I think that it is a common mistake to get too involved with the numbers behind just intonation and forget about writing good music in just intonation. A composer should be able to understand and explain the concepts behind his or her tuning system on a basic level. In depth understanding of tuning should manifest in the composition first and the theory second.

Next I would like to identify more modes and pitch collections within this tuning for future compositions. Most of the music I have written in just intonation is very horizontal so I would like to craft harmonic studies to further understand and navigate the harmonic space of the tuning. Although I am wary about applying just intonation to string quartet if I found the right players I would be inclined to write such a piece. With so many more ratios to explore it is hard to imagine running out of inspiration within just intonation, and meantone and well-tempered temperaments could provide this as well.

My study of Javanese gamelan music has instilled a profound yearning for melodic balance and perfection in all of my music. When applied to my exploration of historical and contemporary tuning systems and how they can be manifested on the piano I have further defined my musical language. I have found that tuning systems themselves have become an outlet for creative expression and that the principles and concepts behind

gamelan do not have to be confined to their original setting. I feel that I have just begun to understand these two concepts and how they can interrelate. In many ways my *Suite for Just Intonation Piano* is a template for both composing in just intonation and for arranging gamelan for piano.